What is BTOP?

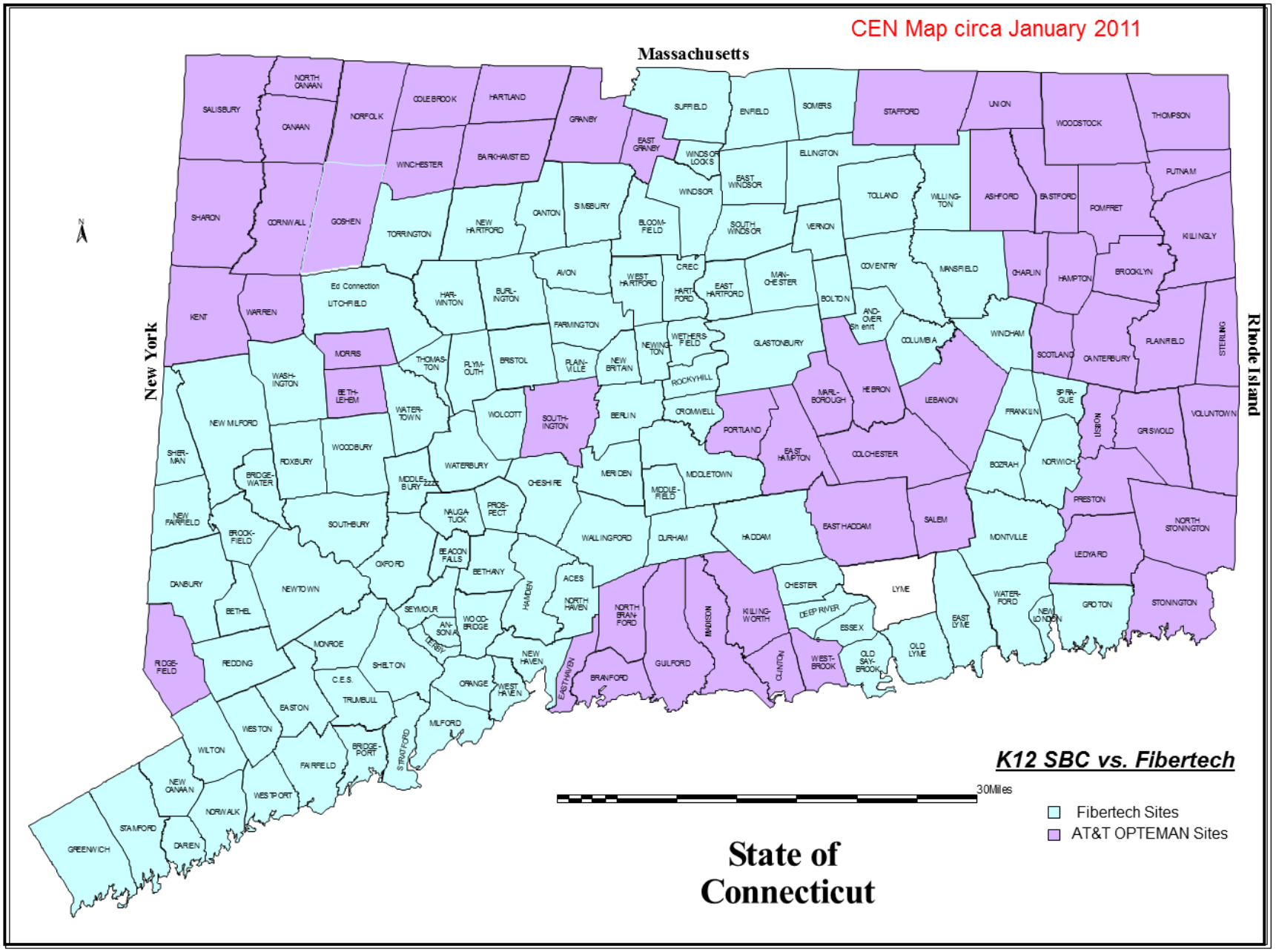
And the future of the CEN Network.

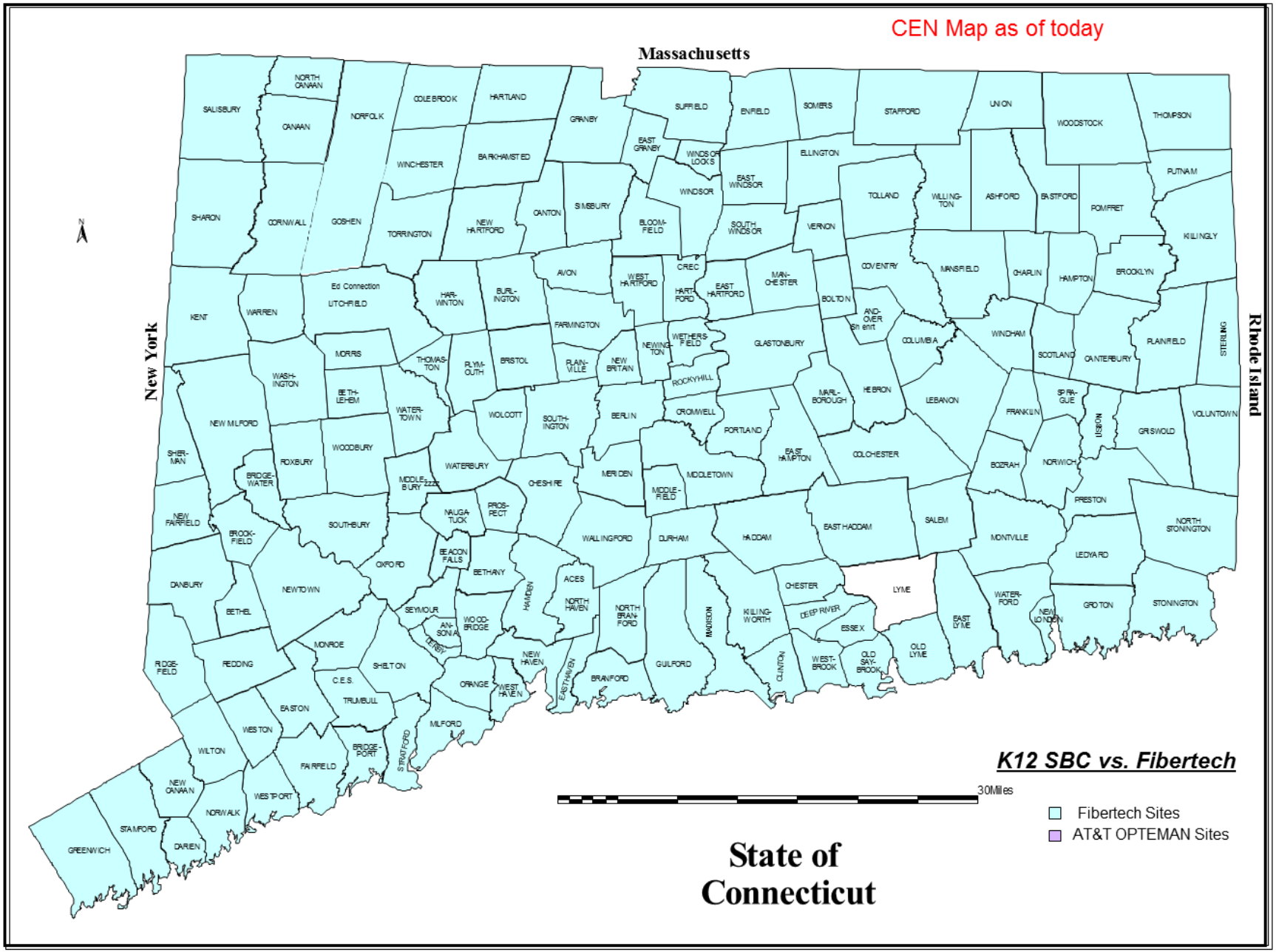
Introduction to BTOP

- Grant awarded on September 3, 2010
- Network construction must be 67% complete by September 2012
- Network must be 100% complete by September 2013
- Network Governance for access, controls and utilization must be developed and implemented before September 2013
- Ensure proportional expenditure of the 20% matching dollars
- On-going sustainability
- “Buy American Act” compliant

BTOP (AKA The Nutmeg Network)

- Objective: To create enhanced connectivity (up to 1Gpbs) to approximately 432 educational related locations including:
  - 231 K-12 Schools
  - 146 Libraries
  - 44 Community Colleges, Universities and other Higher Education facilities
  - 6 CPTV Sites
  - 5 Other Community Support facilities
- Upgrade/refresh of current Network
  - Upgrade existing antiquated network equipment, including 8 year old Network core to support Broadband growth
  - Increased capacity to meet existing demands
  - Scalability to meet the needs of future requirements
- Open access to non-educational use to meet grant's Open Access Requirement


CEN Map circa January 2011
Massachusetts
New York
Rhode Island
N
SALISBURY
NORTH CANAAN
CANAAN
NORFOLK
COLEBROOK
HARTLAND
GRANBY
EAST GRANBY
SUFFIELD
ENFIELD
SOMERS
STAFFORD
UNION
WOODSTOCK
THOMPSON
PUTNAM
WINCHESTER
BARKHAMSTED
WINDSOR LOCKS
EAST WINDSOR
ELLINGTON
SHARON
CORNWALL
GOSHEN
TORRINGTON
NEW HARTFORD
CANTON
SIMSBURY
WINDSOR
BLOOM-FIELD
SOUTH WINDSOR
VERNON
TOLLAND
WILLING-TON
ASHFORD
EASTFORD
POMFRET
KILLINGLY
Ed Connection
LITCHFIELD
HAR-WINTON
BURL-INGTON
AVON
WEST HARTFORD
CREC
HART-FORD
EAST HARTFORD
MAN-CHESTER
BOLTON
COVENTRY
MANSFIELD
CHAPLIN
HAMPTON
BROOKLYN
KENT
WARREN
FARMINGTON
AND-OVER
WINDHAM
SCOTLAND
CANTERBURY
PLAINFIELD
STERLING
MORRIS
THOMAS-TON
PLYM-OUTH
BRISTOL
PLAIN-VILLE
NEW BRITAIN
NEWING-TON
WETHERS FIELD
GLASTONBURY
COLUMBIA
WASH-INGTON
BETH-LEHEM
WATER-TOWN
WOLCOTT
SOUTH-INGTON
BERLIN
ROCKY HILL
CROMWELL
MARL-BOROUGH
HEBRON
LEBANON
SPRA-GUE
NEW MILFORD
PORTLAND
EAST HAMPTON
COLCHESTER
FRANKLIN
USHON
GRISWOLD
VOLUNTOWN
SHER-MAN
ROXBURY
WOODBURY
WATERBURY
MERIDEN
MIDDLETOWN
BOZRAH
NORWICH
BRIDGE-WATER
MIDDLE-BURY
CHESHIRE
MIDDLE-FIELD
PRESTON
NEW FAIRFIELD
BROOK-FIELD
SOUTHBURY
NAUGA-TUCK
PROS-PECT
EAST HADDAM
SALEM
MONTVILLE
NORTH STONINGTON
WALLINGFORD
DURHAM
HADDAM
LEDYARD
DANBURY
BETHEL
NEWTOWN
OXFORD
BEACON FALLS
BETHANY
ACES
NORTH HAVEN
CHESTER
LYME
WATER-FORD
GROTON
STONINGTON
SEYMOUR
WOOD-BRIDGE
HAMDEN
NORTH BRAN-FORD
MADISON
KILLING-WORTH
DEEP RIVER
ESSEX
NEW LONDON
RIDGE-FIELD
REDDING
MONROE
SHELTON
ANSONIA
TIMBY
NEW HAVEN
EAST HAVEN
BRANFORD
GUILFORD
CLINTON
WEST-BROOK
OLD SAY-BROOK
OLD LYME
EAST LYME
C.E.S.
TRUMBULL
ORANGE
WEST HAVEN
EASTON
WESTON
MILFORD
STRATFORD
WILTON
BRIDGE-PORT
FAIRFIELD
NEW CANAAN
WESTPORT
NORWALK
STAMFORD
GREENWICH
DARIEN
K12 SBC vs. Fibertech
30Miles
Fibertech Sites
AT&T OPTEMAN Sites
State of Connecticut


CEN Map as of today
Massachusetts
New York
Rhode Island
SALISBURY
NORTH CANAAN
CANAAN
NORFOLK
COLEBROOK
HARTLAND
GRANBY
SUFFIELD
ENFIELD
SOMERS
STAFFORD
UNION
WOODSTOCK
THOMPSON
PUTNAM
WINCHESTER
BARKHAMSTED
EAST GRANBY
WINDSOR LOCKS
ELLINGTON
EAST WINDSOR
WINDSOR
TOLLAND
WILLING-TON
ASHFORD
EASTFORD
POMFRET
SHARON
CORNWALL
GOSHEN
TORRINGTON
NEW HARTFORD
CANTON
SIMSBURY
BLOOM-FIELD
SOUTH WINDSOR
VERNON
KILLINGLY
CREC
COVENTRY
MANSFIELD
CHARLIN
HAMPTON
BROOKLYN
KENT
WARREN
Ed Connection
LITCHFIELD
HAR-WINTON
BURL-INGTON
AVON
WEST HARTFORD
HART-FORD
EAST HARTFORD
MAN-CHESTER
BOLTON
AND-OVER
Sh enrt
FARMINGTON
WETHERS FIELD
NEWING-TON
GLASTONBURY
COLUMBIA
WINDHAM
SCOTLAND
CANTERBURY
PLAINFIELD
STERLING
MORRIS
THOMAS-TON
PLYM-OUTH
BRISTOL
PLAIN-VILLE
NEW BRITAIN
ROCKYHILL
WASH-INGTON
BETH-LEHEM
WATER-TOWN
WOLCOTT
SOUTH-INGTON
BERLIN
CROMWELL
MARL-BOROUGH
HEBRON
LEBANON
FRANKLIN
SPRA-GUE
LISBON
GRISWOLD
VOLUNTOWN
NEW MILFORD
SHER-MAN
ROXBURY
WOODBURY
BRIDGE-WATER
WATERBURY
MERIDEN
PORTLAND
EAST HAMPTON
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MIDDLE-BURY
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HADDAM
EAST HADDAM
SALEM
MONTVILLE
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NEWTOWN
OXFORD
BEACON FALLS
BETHANY
ACES
NORTH HAVEN
CHESTER
LYME
DEEP RIVER
ESSEX
WATER-FORD
NEW LONDON
GROTON
STONINGTON
BETHEL
SEYMOUR
HAMDEN
NORTH BRAN-FORD
MADISON
KILLING-WORTH
EAST LYME
OLD LYME
WEST-BROOK
OLD SAY-BROOK
CLINTON
REDDING
RIDGE-FIELD
MONROE
SHELTON
ANSONIA
DERBY
WOOD-BRIDGE
NEW HAVEN
EAST HAVEN
BRANFORD
GUILFORD
C.E.S.
TRUMBULL
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WEST HAVEN
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K12 SBC vs. Fibertech
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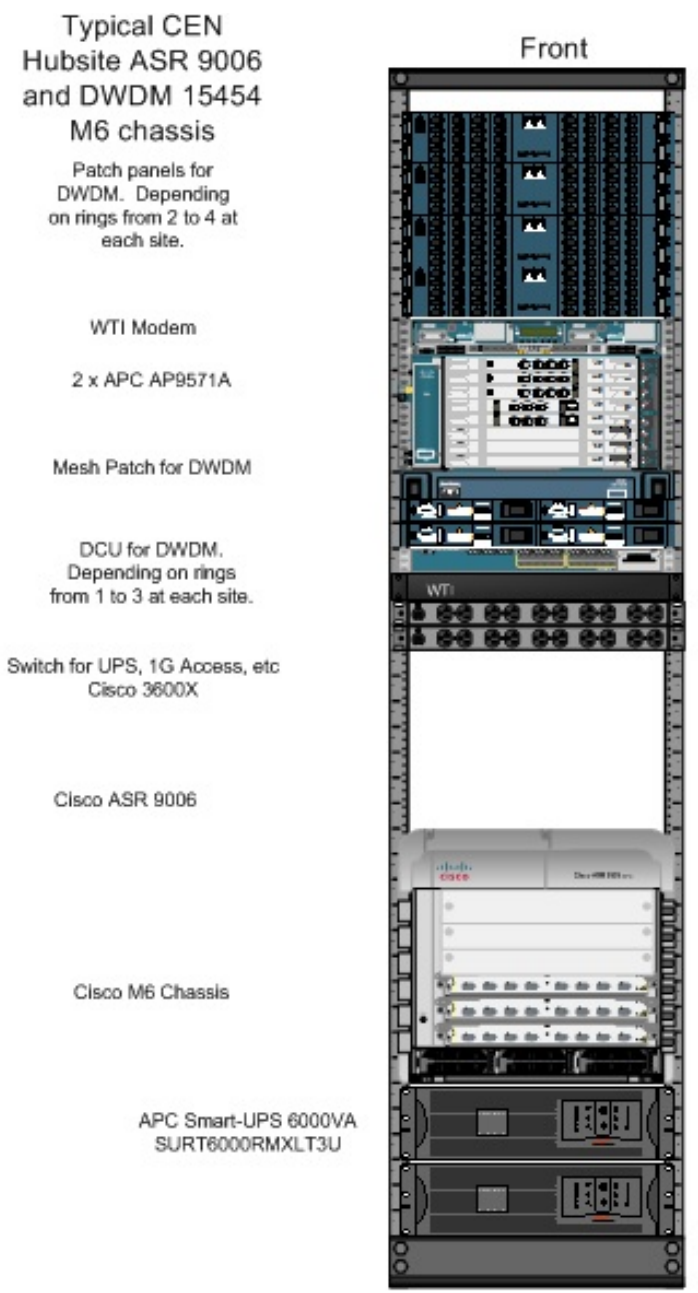
State of Connecticut

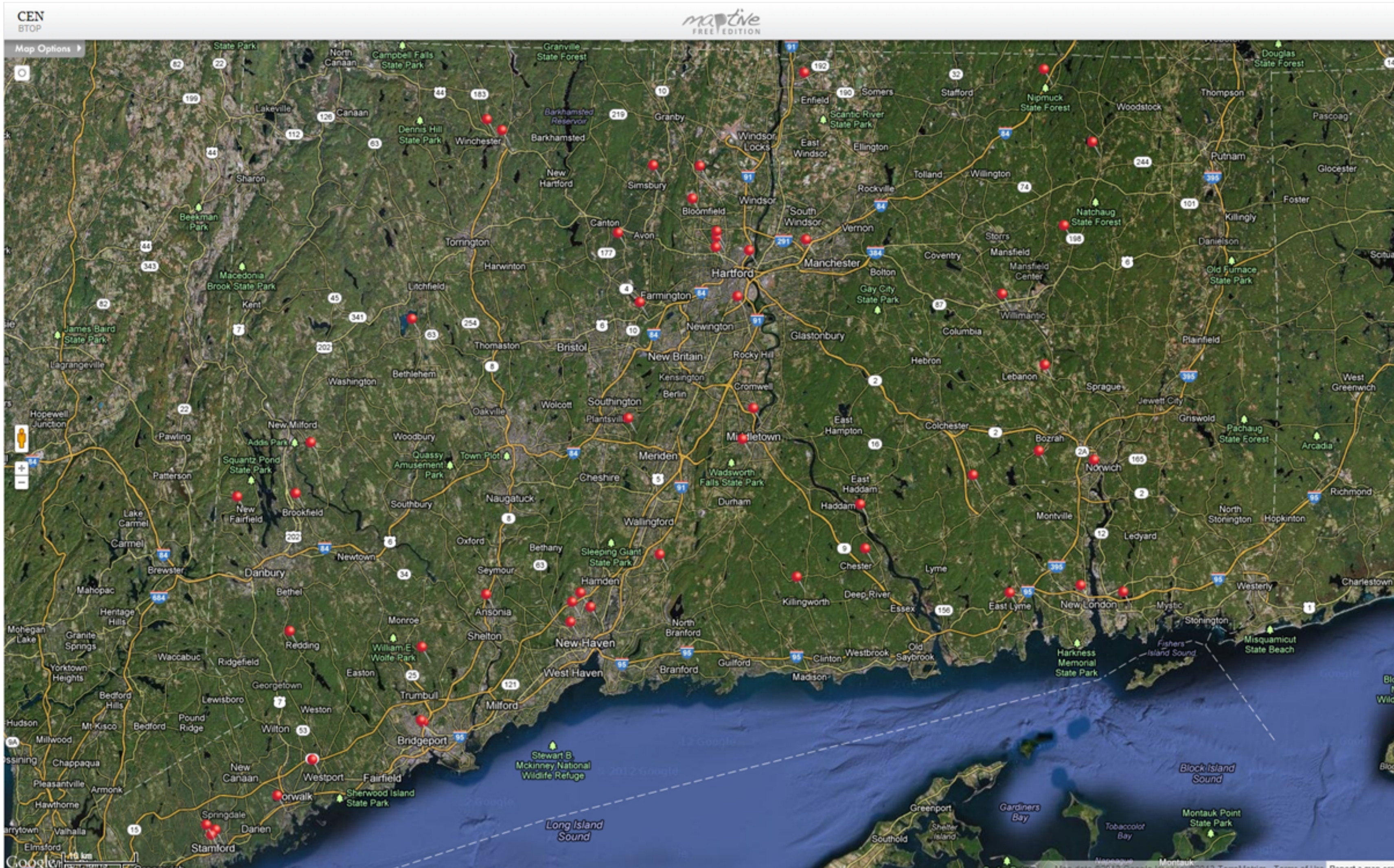
Core Hub Upgrades

- We also had to upgrade 18 hub sites
- We added 3 brand new hub sites with the pictured rack design



Upgrade From Frame Relay and DSL

- As part of the BTOP project, we also upgraded all of our frame relay sites
- Upgraded our DSL library sites that used the most bandwidth
- We also added numerous charter and magnet schools, as well as numerous CPTV sites around Connecticut



CEN
BTOP
Map Options
Hartford
Manchester
New Britain
Bristol
Torrington
Middletown
Meriden
Wallingford
New Haven
West Haven
Milford
Bridgeport
Norwalk
Stamford
Danbury
Waterbury
Naugatuck
Norwich
New London
Farmington
Simsbury
Bloomfield
Windsor
Enfield
Vernon
Glastonbury
Cheshire
Southington
Westport
Fairfield
Darien
Greenwich
Long Island Sound
Block Island Sound
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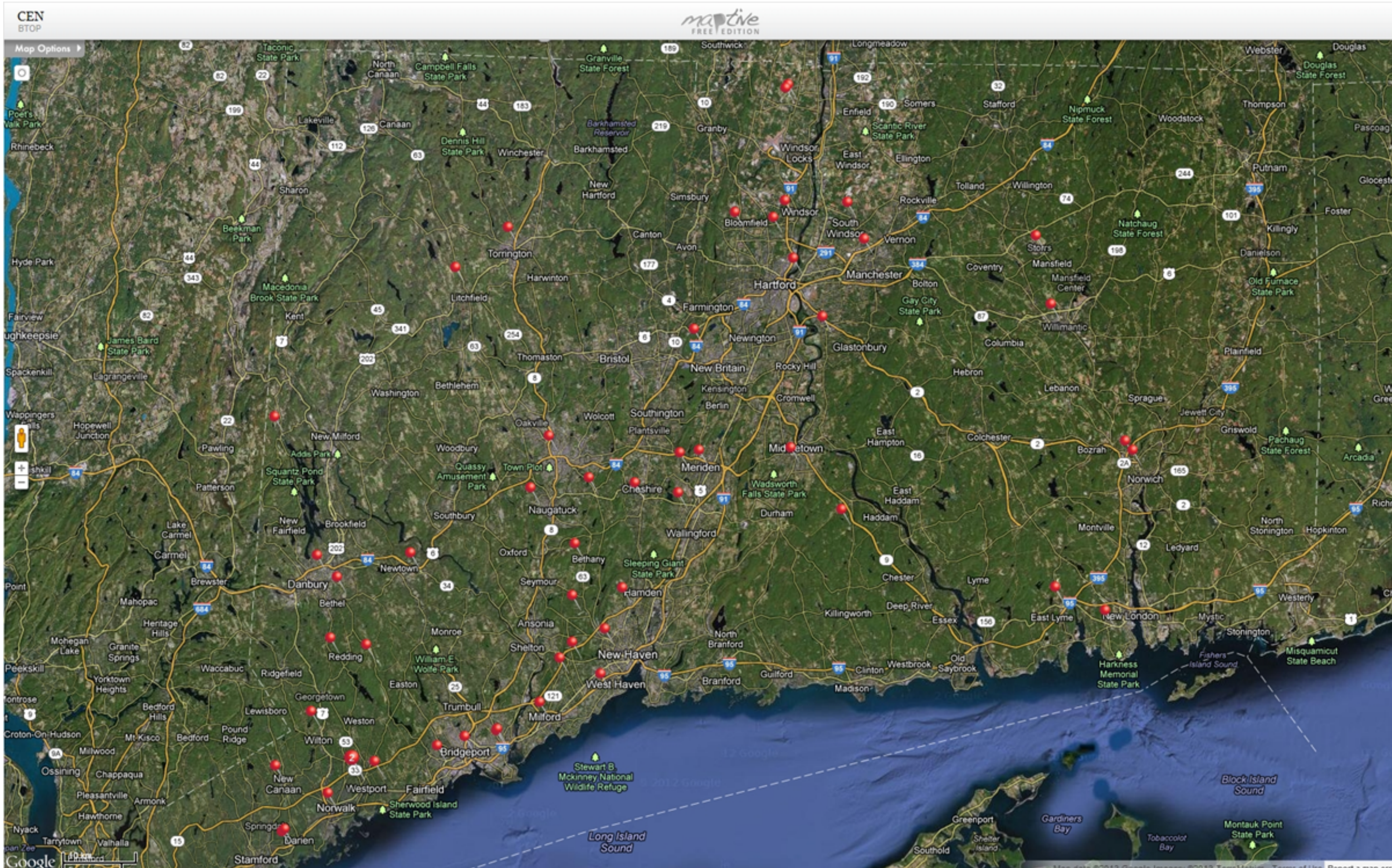
AT&T to CEN Fiber

- In order to move customers from AT&T to CEN Fiber, not only did the OPT-E-MAN sites need to be upgraded, but any member of the ring that the OPT-E-MAN site was added to HAD to be upgraded as well.

- A total of 53 customers have been upgraded from OPT-E-MAN to CEN Fiber



CEN
BTOP
maptive
FREE EDITION
Map Options
Southwick
Longmeadow
Webster
Douglas
Douglas State Forest
Taconic State Park
North Canaan
Campbell Falls State Park
Granville State Forest
Enfield
Somers
Stafford
Nipmuck State Forest
Woodstock
Thompson
Lakeville
Canaan
Dennis Hill State Park
Winchester
Barkhamsted Reservoir
Barkhamsted
Granby
Windsor Locks
Scantic River State Park
East Windsor
Ellington
Pascoag
Rhinebeck
Putnam
Gloucester
Sharon
New Hartford
Simsbury
Windsor
Rockville
Tolland
Willington
Foster
Beekman Park
Canton
Bloomfield
South Windsor
Vernon
Natchaug State Forest
Killingly
Torrington
Avon
Storrs
Danielson
Hyde Park
Harwinton
Hartford
Manchester
Coventry
Mansfield
Mansfield Center
Old Furnace State Park
Macedonia Brook State Park
Litchfield
Farmington
Bolton
Gay City State Park
Fairview
Kent
Newington
Glastonbury
Willimantic
Poughkeepsie
James Baird State Park
Thomaston
Bristol
New Britain
Rocky Hill
Columbia
Plainfield
Spackenkill
Lagrangeville
Bethlehem
Washington
Kensington
Berlin
Hebron
Lebanon
Wappingers Falls
Hopewell Junction
New Milford
Oakville
Wolcott
Southington
Plantsville
Cromwell
Sprague
Jewett City
Griswold
Pawling
Woodbury
Middletown
East Hampton
Colchester
Bozrah
Pachaug State Forest
Arcadia
Squantz Pond State Park
Quassy Amusement Park
Town Plot
Meriden
Norwich
Patterson
Naugatuck
Cheshire
Wadsworth Falls State Park
East Haddam
Southbury
Durham
Haddam
Lake Carmel
New Fairfield
Brookfield
Wallingford
Montville
North Stonington
Hopkinton
Richmond
Carmel
Newtown
Oxford
Bethany
Sleeping Giant State Park
Ledyard
Brewster
Danbury
Seymour
Chester
Lyme
Westerly
Mahopac
Bethel
Hamden
Deep River
East Lyme
New London
Mystic
Heritage Hills
Ansonia
Killingworth
Essex
Stonington
Mohegan Lake
Granite Springs
Monroe
North Branford
Redding
Shelton
New Haven
Misquamicut State Beach
Peekskill
Waccabuc
Ridgefield
William E. Wolfe Park
Westbrook
Old Saybrook
Harkness Memorial State Park
Fishers Island Sound
Yorktown Heights
Easton
West Haven
Branford
Guilford
Clinton
Madison
Georgetown
Trumbull
Bedford Hills
Lewisboro
Weston
Milford
Croton-On-Hudson
Mt Kisco
Bedford
Pound Ridge
Wilton
Bridgeport
Millwood
Stewart B. Mckinney National Wildlife Refuge
Block Island Sound
Ossining
Chappaqua
New Canaan
Westport
Fairfield
Pleasantville
Armonk
Norwalk
Sherwood Island State Park
Greenport
Gardiners Bay
Montauk Point State Park
Hawthorne
Nyack
Springdale
Darien
Shelter Island
Long Island Sound
Tobaccolot Bay
Tarrytown
Valhalla
Southold
Stamford
White Plains
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Next-Gen Backbone

- Our next phase of upgrades will upgrade the remaining customers on our fiber backbone to our next-gen backbone.

- This upgrade will give our customers 1Gb handoffs and 10Gb backbones *(compared to current 100Mb handoffs and 1Gb backbones)*

Continuing Upgrades

- Our next round of upgrades is based on how much bandwidth a site uses
- The highest users got placed at the top of the list, while the lowest users were placed on the bottom
- In some instances, a very high usage site in the same ring as a low usage site, so you may see lower usage sites mixed in
- This is because we have to upgrade the entire ring

Overview *(Old Network Setup)*

- Network Setup
  - Minimum Customer Backbone Connection = 1Gb/sec
  - Minimum Customer Handoff Connection = 100Mb/sec
- Customer Edge Equipment
  - Cisco 3500/3600/3700 devices supporting only 100Mb handoffs and 1Gb backbone links
- Layer 1/2 Access
  - Frame Relay, ATM, and Dark Fiber
- Layer 3 Access
  - Cisco 6500 series

Overview *(Next Generation Network Setup)*

- Network Setup
  - Minimum Customer Backbone Connection = 10Gb/sec
  - Minimum Customer Handoff Connection = 1Gb/sec
- Customer Edge Equipment
  - Cisco 3600ME devices supporting full MPLS and multiple choices for handoffs *(support most any SFP 1Gb) (also 10Gb backbone links)*
- Layer 1/2 Access
  - Cisco ONS 15454 DWDM – Up to 40 10Gb circuits per hub
- Layer 3 Access
  - Cisco ASR 9000 Series – Multiple 10Gb connections per blade

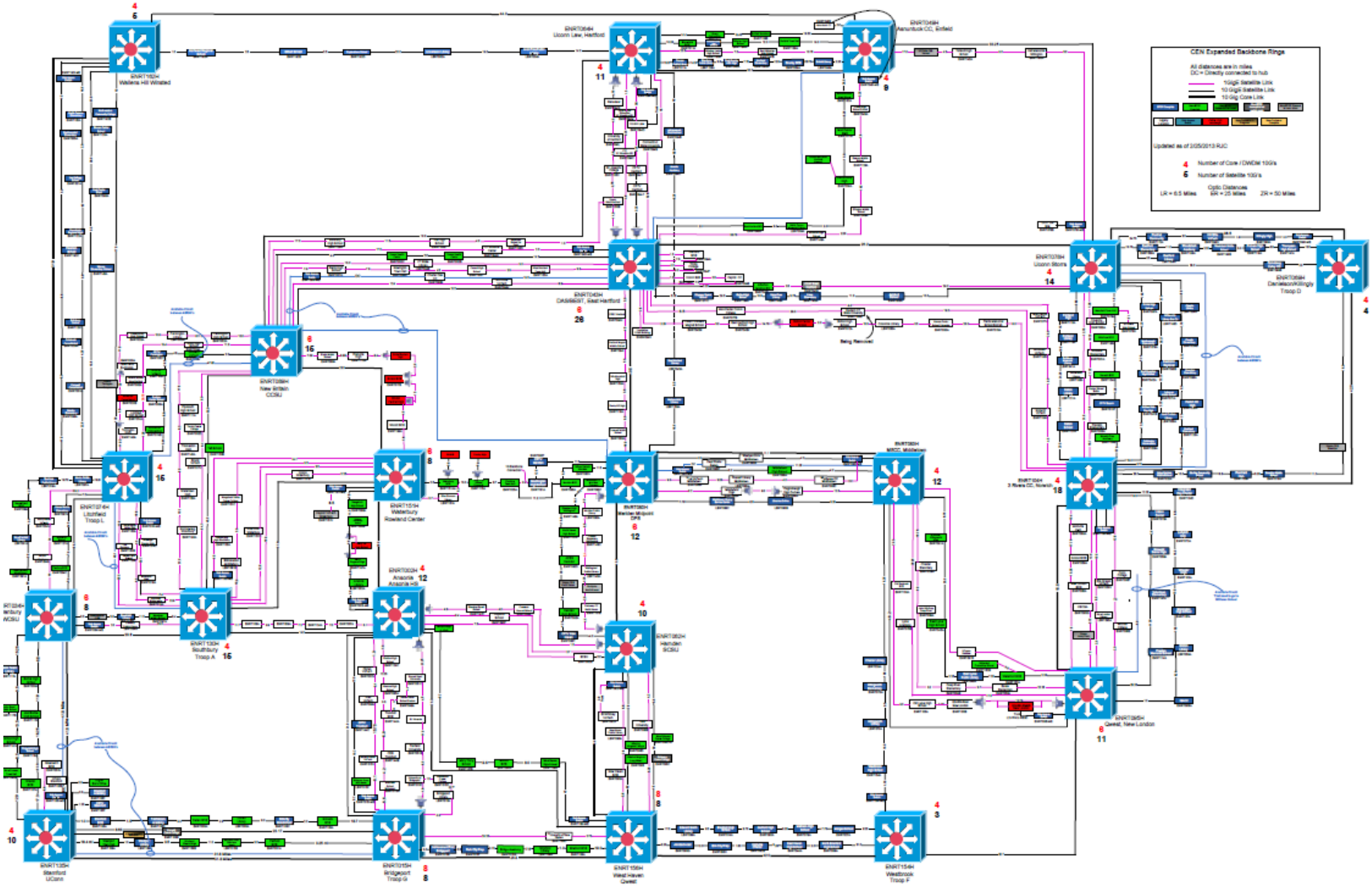
Next Steps

- Upgrade remaining fiber customers to next gen network
- Implement 100Gb optical solution from East Hartford to Storrs to Internet2 *(will give us 100Gb upstream to Internet2)*

Final Steps

- We will still have around 99 libraries that are on DSL after all of this

- Within the next 5 years we would like to work on getting them off DSL and onto CEN fiber, along with upgrading their customer edge equipment



Current network map (not including DSL libraries)

Top Ten SpeedTest.Net Download Results (Within last 90 days)

CLIENT_IP	CLIENT_CITY	Customer of CEN	TEST_DATE	SERVER_NAME	DOWNLOAD_KBPS	UPLOAD_KBPS
137.99.54.136	Storrs Mansfield	University of Connecticut	4/28/2013 03:50:49 GMT	Hartford, CT	908859	56968
72.10.98.226	Litchfield	Education Connection	4/1/2013 18:58:14 GMT	Hartford, CT	711923	57633
128.36.198.125	New Haven	Yale University	4/19/2013 01:34:33 GMT	Hartford, CT	687852	49487
155.43.78.6	Hartford	Community-Technical Colleges	4/30/2013 00:18:41 GMT	Hartford, CT	655838	28092
138.29.16.23	New London	Coast Guard Academy	4/18/2013 17:58:19 GMT	Hartford, CT	564043	32087
72.10.103.142	East Haddam	Nathan Ray Hale High School	4/10/2013 20:03:53 GMT	Hartford, CT	557481	130556
64.251.53.99	Weston	Weston Public Schools	4/16/2013 12:24:32 GMT	Hartford, CT	549757	128138
192.132.64.3	West Haven	University of New Haven	4/10/2013 16:09:42 GMT	Hartford, CT	536103	82490
64.251.48.163	Wallingford	Wallingford Public Schools	4/18/2013 12:49:48 GMT	Hartford, CT	512572	179081
64.251.57.10	Bethel	Bethel Public Schools	4/13/2013 02:04:17 GMT	Hartford, CT	477522	70361

Largest result seen is Windham Public Schools @ 990Mb/Sec download